



MARKSCHEME

November 2007

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

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Subject Details: Environmental Systems SL Paper 2 Markscheme

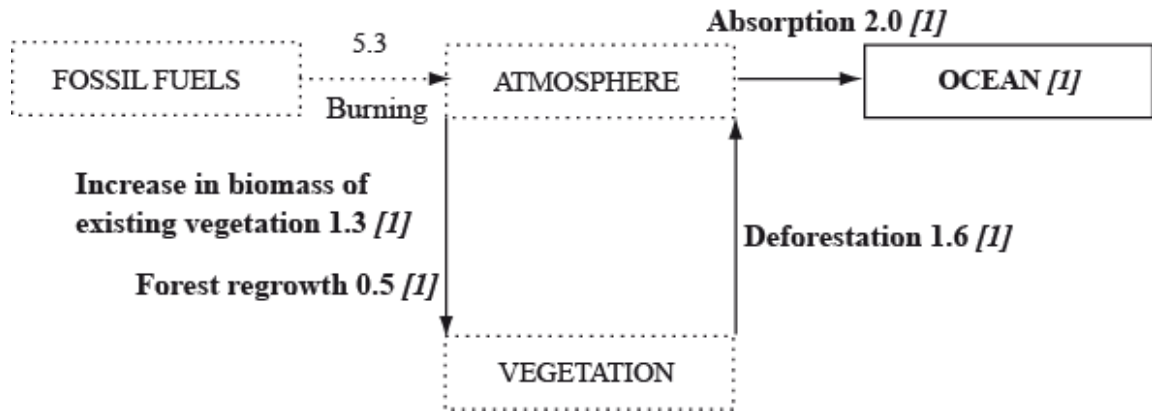
General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ Words that are underlined are essential for the mark.
- ♦ The order of points does not have to be as written (unless stated otherwise).
- ♦ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- ♦ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- ♦ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ♦ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- ♦ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- ♦ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

1. (a) Award marks for 4 flows and 1 storage as shown on diagram.
Flows must be linked to an arrow in the correct direction and include both number and process to gain the mark.



[5]

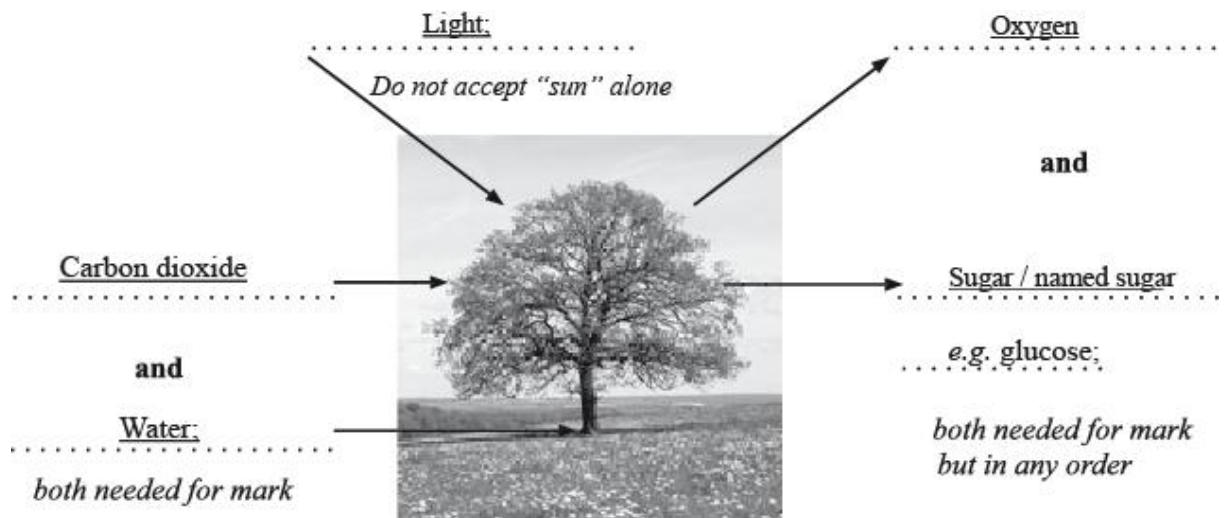
- (b) 3.1×10^9 / 3 100 000 000 / 3.1 billion tonnes / 3.1 Gigatonnes / 3.1 Gt
Powers of ten and units must be correct for credit.

[1]

- (c) (i) Photosynthesis;

[1]

(ii)



[3]

Allow as alternatives to "light": sunlight, solar energy, insolation.

- (d) (i) carbon dioxide is a greenhouse gas / causes the greenhouse effect;
increasing levels of carbon dioxide may cause global warming / melting of
ice caps / rising sea levels / shifting of biomes / changes in weather patterns /
disruption of ocean currents / increased rates of extinction / reduction in crop
yields; [2 max]

Allow any other reasonable points

- (ii) some countries co-operate with other nations to agree limits to global carbon
emissions;
e.g. recent ratification of Kyoto Protocol (Treaty) by many countries;
specific details about which countries have agreed to/rejected controls on
their carbon emissions;
specific details about actions agreed to by specific countries;
e.g. use of carbon or energy taxes;
developed countries assist less developed countries to install cleaner
technology;
trading in carbon credits/exchanges; [3 max]

*Allow other relevant points, provided they relate to international
cooperation*

2. (a) a parasite lives in or on another (host) organism/species and gains all or much of its food from that organism (usually without killing it) OWTTE;
a predator is an animal that hunts another animal and kills it for food OWTTE; [2]
- (b) (i) pyramid of numbers; [1]
“pyramid” alone is insufficient; allow Eltonian pyramid.
Do not allow: biomass pyramid, food-chain, food-web.
- (ii) parasites are usually much smaller than their host;
so many of them can feed on a single organism at a time; [2]
more than one species of parasite may live on a single host;
parasites can breed more quickly than herbivores;
- (c) energy available higher up a food chain is limited by energy fixed by producers;
losses due to respiration reduce available energy/much energy (about 90%) is converted to heat at each level of the food chain;
because all organisms must transform some energy to heat to carry out their metabolic functions;
as implied by the Second Law of thermodynamics;
predators are always near the top of food chain/at third trophic level or above;
so much of the available energy/production from producers is converted to heat and lost from the system before it reaches the predators; [3 max]

3. (a) (i) natural increase rate = $\frac{\text{births per thousand} - \text{deaths per thousand}}{10}$ /
 natural increase rate = $\frac{\text{crude birth rate} - \text{crude death rate}}{10}$ /
 (percentage) rate at which a population increases per year; [1 max]
- (ii) $\frac{13-16}{10} = -0.3\%$ (*minus sign not required*) [1]
- (b) (i) decrease;
 Allow: *decline/fall/go down*. [1]
- (ii) death rate exceeds birth rate / negative rate of increase;
 number of children per female too low for replacement;
 relatively long generation time (of 29 years); [2 max]
- (c) *In developing countries:*
 lack of access to contraceptives;
 lack of education about family planning;
 lack of educational opportunities other than about family planning;
 culture/religion *e.g.* women's perceived role in Islamic societies;
 lack of employment opportunities;
- In developed countries:*
 better access to contraceptives;
 good education about family planning;
 many education opportunities;
 culture *e.g.* women expected to have a career and bring up a family;
 wider employment opportunities;
 women reluctant to sacrifice affluent lifestyle to have children (dependent on 2 incomes for mortgage *etc.*); [2 max]
- Accept other relevant points*
Do not credit the same point from different lists twice.

SECTION B

General Essay Markscheme

Each essay is marked out of **[20]** of which **[3]** are for expression and development of ideas (EDI).

- [0]** No expression of relevant ideas.
- [1]** Expression and development of relevant ideas is limited.
- [2]** Ideas are relevant, satisfactorily expressed and reasonably well developed.
- [3]** Ideas are relevant, very well expressed and well developed.

Reward detail, sound environmental / ecological concepts, and good examples even if not stated exactly in the form given in the markscheme.

4. (a) Composition [4 max]

mostly nitrogen and some oxygen / approximately 80% nitrogen and 20% oxygen / 78% nitrogen and 21% oxygen;
 small percentages (1% or less) of other named gases (*any two of* argon, ozone, methane, SO_x, NO_x, helium, neon, hydrogen, krypton, xenon);
 (variable percentage of) water vapour (1% – 4%);
 small percentage of carbon dioxide (0.03–0.04%);

Structure [4 max]. Information may be given in the form of a diagram. Must mention troposphere and stratosphere for full credit.

atmosphere consists of a number of layers;
 layer adjacent to Earth's surface is the troposphere and layer above troposphere is the stratosphere;
 correct details of thickness of any named layer;
 density of layers decreases with height;
 ozone layer lies in lower part of stratosphere;
 in troposphere temperature decreases with height (lapse rate);
 in stratosphere temperature increases with height;
Allow any other reasonable points

[7 max]

(b) Formation [4 max]

formed from by-products of combustion of fossil fuels / vehicle emissions;
 nitrogen (di)oxide is broken up by action of sunlight;
 releases reactive oxygen atoms that combine with oxygen molecules to form ozone;
 commonly forms in places with sunny climates and high traffic density;
 worse in areas where topography limits air circulation;
 example of city badly affected, *e.g.* Los Angeles /Santiago/Mexico City/Athens;
Do not award marks for information on stratospheric ozone.

Consequences [2 max]

breathing difficulties in humans and animals;
 eye irritation;
 increased rates of respiratory disease;
 reduced productivity / damage to crops/forest;
Allow any other reasonable points e.g. details of chemical processes

[6 max]

- (c) *Award [2 max] for methods (M) and [2 max] for evaluation (E) of methods.*
- traffic congestion charges; (M)
 - may have economic impact / politically unpopular; (E)
 - requires monitoring system; (E)
 - difficult to collect fines; (E)
 - may bankrupt / prevent from travelling to shift work (the poor and ill-educated); (E)
 - have reduced pollution substantially in some cities;(E)
 - e.g.* London has put system in place/other cities (*e.g.* Sydney) considering it;(E)
- improving transport services / reducing charges on public transport; (M)
- requires substantial capital investment; (E)
- use of electric vehicles; (M)
- vehicles have limited range/speed; (E)
- pollution transferred to area of power station (unless electricity generated by nuclear/renewables); (E)
- use of hybrid vehicles (can switch between petrol and electric); (M)
- encouraged by exemption from charges; (E)
- overcomes problem of limited range of electric vehicles; (E) **[4 max]**

Allow other relevant suggestions

Expression of ideas: [3 max]

5. (a) natural capital is a natural resource that when suitably managed can produce a natural income in the form of goods or services / natural capital is the standing stock of a natural resource available on the Earth / OWTTE;
natural income is the yield or harvest taken from a natural resource; [2]
- (b) sustainable yield is the maximum natural income/yield or harvest that can be taken from a natural resource;
without exceeding the rate of natural renewal / damaging the ability of the resource to regenerate itself;
- (i) *Renewable resource [3 max]. Answers will vary with examples.*
timber/food/fibre from living organisms *e.g.* cod;
monitor stocks to ensure stock is stable/rate of exploitation \leq rate of regeneration;
use quotas to limit catches to maintain breeding stock;
set minimum net size to allow small fish to escape and reproduce;
designate reserves/no fishing areas to encourage breeding;
closed seasons when harvesting is not permitted;
- (ii) *Replenishable resource [3 max]. Answers will vary with examples*
non-living resource replenished by solar energy *e.g.* fresh water;
monitor rates of replenishment and extraction to ensure rate of extraction is \leq rate of replenishment;
use “grey” water for non-potable applications;
fix leaks;
encourage use of water efficient domestic appliances;
hose pipe bans in dry years to reduce consumption;
divert water to refill reservoirs/aquifers in wet years; [8]

Allow other reasonable suggestions

- (c) carrying capacity - maximum population that can be sustained without permanent damage to life supporting systems / OWTTE;
technology requires exploitation of a range of natural resources often at unsustainable rates;
up until now technological solutions have always been found to solve problems;

technology has enabled humans to increase food production by using fossil fuels to mechanise farming, increasing yields;
but fossil fuels will eventually run out;
but mechanised cultivation methods often damage or destroy soil;
use of pesticides and fertilizers to increase yields may permanently pollute/damage water and soil;

transport systems allow goods to be distributed across the globe;
technology and transport enable humans to live in cities at higher densities;
but transport releases carbon dioxide increasing global warming / climate change *etc.*;

technology can destroy natural systems that may absorb waste;
but technology can be used to clean up waste and pollution;
information age has enhanced remote communication, (in theory) reducing need for global travel;
toxic pollutants have (*e.g.* radionuclides, heavy metals, organic chemicals) spread throughout ecosystems;
changes in global temperature could damage food production systems;
rises in sea level may destroy major cities;

[7 max]

Allow other reasonable points, but response must have some discussion about implications for carrying capacity of effects of technology and contain points from both sides of the argument for full credit.

Expression of ideas: [3 max]

6. (a) *pioneer communities [4 max]*
pioneer communities have low diversity;
because few species are adapted to survive in the relatively harsh conditions of a newly available habitat;
because it takes time for new species to invade a newly available habitat;
e.g. in sand dune succession on Western Australian coast, young dunes have only 4 or 5 low shrub species *e.g. Olearia axillaris*;

pioneer communities have low productivity (gross and net);
because individuals are often thinly distributed in a single low growing layer;
because early colonisers are generally small in size, so have limited potential for productivity;
because food chains and webs are short and simple;

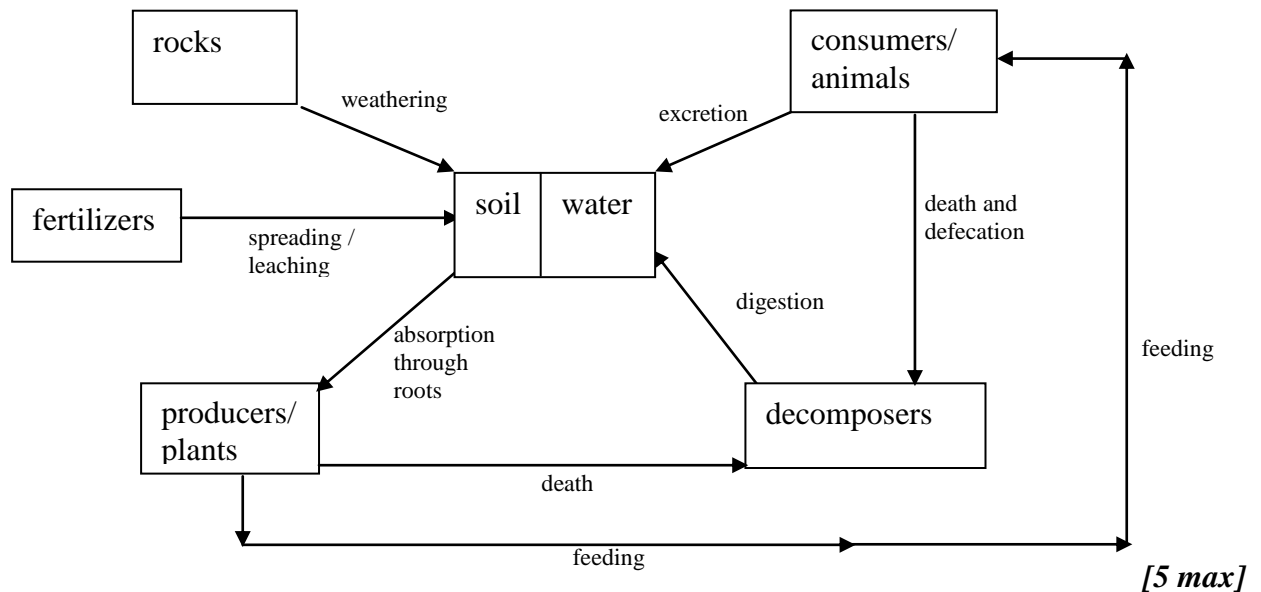
climax communities [4 max]
climax communities have high diversity;
because there are a wide range of niches/foods/shelters available;
e.g. in sand dune succession on Western Australian coast, older dunes have a wide range of shrub and ground flora species;

climax communities have a high gross productivity;
because of many layers/complex food webs to capture energy;
climax communities have a low net productivity;
because of high rates of community respiration;
because system has reached equilibrium, so inputs = outputs;

[7 max]

At least one point on diversity and one point on productivity must be included for each community, for full credit.

- (b) [1] for each pair of correct storages [2 max]
[1] for each pair of correct flows (process and direction must be correct) [3 max]



Soil/water storages may be combined or separate. If combined count as a pair

Allow other relevant flows

- (c) early in succession, there is little soil so producer pioneers rely on weathering of rocks to release phosphorus;
early in succession there are few consumers so cycling by decomposers and consumers is low;
in mid-stages of succession, phosphorus is actively cycled round between organisms and soil/water by action of decomposers;
phosphorus storage increases in soils as soils build up through mid and late succession;
phosphorus is relatively insoluble so is not easily leached from soils;
in late succession, larger quantities of phosphorus are locked up in large biomass of organisms;
fast cycling of phosphorus by decomposers is important in late succession because more phosphorus is locked up in biomass;
weathering of rock and soil continues to input phosphorus to system at all stages of succession;

[5 max]

Allow any other reasonable suggestions

Reference to more than one stage of succession is needed for full marks

Expression of ideas: [3 max]